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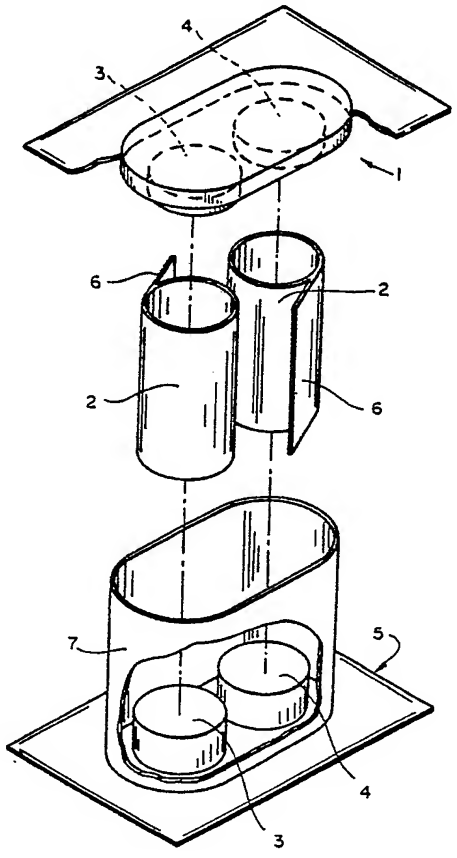
(54) Title: SEALING ELEMENT AND METHOD OF MAKING SAME

(57) Abstract

A sealing element comprising a mold (7) with a hollow cylindrical configuration having therein a polymeric gel with a cone penetration value of about 30 to about 400 (10^{-1} mm) and an elongation of from about 25% to about 850% and at least one cylindrical mandrel (2) positioned in the mold (7) such that the polymeric gel has one or more holes extending at least partially therethrough. The mold (7) and mandrels (2) are made of a material having a flexural modulus of at least about 4 x 10^3 psi that is substantially incompatible with the polymeric gel, is dimensionally stable at the temperature the polymeric gel was formed, and has a release rate of at least 0.02 in/sec on 180° peeling. A method of making a sealing element is also disclosed.



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SEALING ELEMENT AND METHOD OF MAKING SAME

BACKGROUND OF THE INVENTION

a) The Invention

The invention relates to a packaged gel article. The invention further relates to the method of making a packaged gel article.

b) Background Information

At various places in an electrical distribution system, an electrical cable is divided into two or more components, for example, where a branch-off cable is connected to a main cable or where a cable containing two or more cores, is separated into the individual cores. Where one or more cables or cores are divided from the main cable, the cable insulation generally has been removed to permit the jointing of a branch-off cable or breakout of the cable cores. The area where the insulation has been removed must then be reinsulated. In the case of shielded or armored power cables, the shielding and armoring is also removed and must be re-established. This is generally accomplished by installing an enclosure around that region of the cables. The term "breakout" is used in this application to refer to either two or more cables or two or more cores where they separate from a main cable or cables.

Enclosures suitable for this use can be, for example, resin filled joint cases, polymeric sleeves or the like. The location where the individual cables exit from an enclosure, the area between the cables and between the cables or cores and enclosure must be sealed to prevent ingress of

moisture. A number of methods have been used to seal breakouts with varying success. A heat shrinkable polymeric boot may be positioned on the breakout using mastic or adhesive to hold the boot in place. Heat shrinkable boots however are costly to manufacture because of their shape and usually require access to the cable conductor ends to slip the boot into the proper position over the breakout area. Adhesives and mastics have been put in the area between the breakout cable core and the main cable (crotch area) to seal but these are difficult to pack into the crotch area without leaving voids resulting in a poor seal and may require heat to cause them to flow and fill the crotch area. The application of heat can damage the conductor covering or the conductor. Tapes of dimensionally stable polymeric material with an adhesive or mastic have been used to wrap the cable breakout area but tend to leak if not properly overlapped.

Shaped articles have been used as sealing elements in a variety of methods. In US 4,438,294 a sealing element of a thermoplastic or plastic material for a cable entrance socket is disclosed. The sealing element seals the area between the sheaths of cables using straight sided or concave articles which surround only a portion of the cable and conductors in the crotch area. No gels are disclosed and the thermoplastic or plastic materials described are substantially non-tacky and rigid.

In Great Britain Patent No. 2,057,202 polymeric article is described comprising a cylindrical member with a plurality of channels for enclosing a pluralitv of cables. The

articles may seal by being made heat recoverable or may be sealed with an adhesive or mastic. They are non-tacky, and useful to seal, protect and insulate cables. No gels are described. In US Patent No. 4,298,415 a branch off seal is disclosed comprising a heat recoverable sleeve and one or more clips attached to the sleeve opening to form the sleeve into a desired number of cable conduits.

A variety of molds for casting shaped articles are well known. Reusable molds made of metal, polymers, glass and ceramics are used in casting a wide variety of polymeric shapes and articles. Reusable molds are generally expensive to make and require that the article formed therein be packaged and handled separately. Disposable molds come in a variety of materials, for example wax.

In application Serial No. 859,160 (Attorney's docket number MP1047-US2) filed concurrently herewith, shaped articles of a polymeric gel are described which are useful in sealing a cable bracket. These shaped articles of polymeric gel are useful for sealing the area between two or more cables and an enclosure at the location where the cables exit from the enclosure. It also describes shaped article of a polymeric gel which are useful for sealing the ends of cables. These shaped articles of a polymer gel, are tacky to the touch i.e., are relatively sticky and will pickup dirt, finger prints and the like and therefore may exhibit some degree of handling difficulties, especially installation and may exhibit storage problems.

SUMMARY OF THE INVENTION

It has been discovered that when shaped articles of a polymeric gel are formulated into the packaged gel article of invention the resultant packaged gel article may be handled and the shaped article installed using the container in which it is made, thus overcoming the difficulties of the prior art.

The invention relates to a packaged gel article and a method of manufacturing a packaged gel article.

The packaged gel article comprises a mold and a shaped article:

a) said mold comprising a hollow cylindrical configuration having a circumference substantially corresponding to the shaped article which is in the mold;

b) at least one cylindrical mandrel positioned in the mold such that the shaped article has one or more holes extending at least partially therethrough;

c) said mold having therein a shaped article comprising a polymeric gel. The gel having a cone penetration value of about 30 to about 400 (10^{-1} mm) and an elongation of from about 25% to about 850%

d) said mold and mandrels being made of a relatively rigid material having a flexural modulus of at least

about $4x10^3$ psi that is substantially incompatible with the shaped article, is dimensionally stable at the temperature the gel was formed at and has a release rate from the gel composition of at least 0.02 in/sec on 180° peeling.

The invention also relates to a method of manufacturing a shaped article having one or more holes extending at least partially therethrough and a mold, which method comprises:

a) selecting a mold comprising a hollow cylindrical configuration having a circumference substantially corresponding to the desired dimension of the shaped article; said mold being closed at one end;

b) placing in the mold a liquid composition to a depth sufficient to provide the desired configuration of the shaped article, said composition comprising a polymeric material capable of forming a gel;

c) positioning at least one cylindrical mandrel at least partically through the liquid composition to displace the liquid material; and

d) subjecting the polymeric material to conditions to provide a gel composition having a cone penetration value of 30 to 400 (10^{-1} mm) an elongation of about 25% to about 850%;

said mold and mandrels being made of a relatively rigid material having a flexural modulus of at least about

$4x10^3$ psi that is substantially incompatible with the shaped article, is dimensionally stable at the gel forming temperature and has a release rate from the gel composition of at least 0.02 in/sec on 180° peeling to obtain a shaped article having one or more holes extending at least partially therethrough, the number of holes corresponding to the number of mandrels used in step (c).

DETAILED DESCRIPTION OF THE INVENTION

The mold of the invention is made of a relatively rigid material having a flexural modulus of at least about $4x10^3$ psi that is substantially incompatible with the shaped article, is dimensionally stable at the temperature the gel is formed at and has a release rate from the gel composition of at least 0.02 in/sec on 180° peeling. While other organic or inorganic materials may be suitable for the mold e.g. certain metals or alloys, it is preferred in the invention that the mold be made of a polymeric material. Preferred polymers include polycarbonates, polyethylene, polypropylene, polystyrene, ABS, polyester, polyamides, fluoropolymers and silicone surface treated plastics. Especially preferred are polycarbonates.

The mold material must be dimensionally stable at the gel forming temperature i.e. must have a melting point or glass transition temperature higher than the highest temperature that the liquid composition capable of forming a gel attains during the making of the shaped article in the mold. It can also be supported during gel formation e.g.

an exterior support in order to maintain the dimensional stability.

By relatively rigid is meant that the mold material has a flexural modulus of at least about $4x10^3$ psi and preferably from about $0.5x10^5$, and preferably up to $1.25x10^6$ psi measured by ASTM D790. It is also meant to describe the properties of remaining dimensionally stable during formation and storage. The mold material must be flexible enough to be removed on installation of the gel material.

The mold material must release from the gel relatively easily during installation of the shaped article e.g. on a cable breakout. If the release rate is too low the shaped article may tear or stretch out of shape and thus be unusable. It has been found that a lower degree of releasability is preferred. Since the shaped article is to be stored in the mold, it is preferred that the shaped article stick in the mold enough to keep from falling out due to general gravitational or other minor pulling forces. In general the release rate should be at least 0.02 in/sec. for a one-eight inch thickness of polymeric gel on a 6 inch 1 inch strip of mold material to which a 1 lb. weight has been attached such that the pulling force is at an angle of 180° to the mold material. The releaseability can be achieved either by the material chosen for the mold itself or by coating or lining the interior of the mold to control release.

It is optionally preferred that the mold material be notch sensitive. By notch sensitivity is meant that the

material will readily break under normal manual pressure once the material has been notched or scored to facilitate removal of the mold material. Notch sensitivity is measured by ASTM D-256. Notch sensitivity is desirable to aid in the removal of the mold or part of the mold from the shaped article. After scoring the mold, pressure applied to the area around the score by squeezing or the like will cause the mold material to break along the score. The edge formed at the break can be grasped to pull the mold away from the shaped article.

Optionally a portion of the mold material can be left on the shaped article upon installation. The remaining mold portion may act as a cover or other protective means for any exposed portions of the shaped article. Appropriately when it is determined that it is desirable to leave a portion of the mold in an electrical use, it is appropriate to chose the mold material to be electrically conductive, stress grading or insulating as appropriate similar to the shaped article on use.

The mold may be formed by any convenient means based on the material chosen for the mold. So for example, where polymers are chosen the mold may be made by extrusion, or thermoforming such as blow or injection molding.

The mandrels are chosen with the same requirements as the mold material. The mandrels are designed preferably cylindrically such that when inserted into the mold the mandrels will cause holes to be formed at least away through

the shaped article. The number of mandrels should correspond to the number of holes desired in the shaped article. The mandrel may also be an integral part of the mold. The hole may be formed on the edge of the article (Figure 6) by such integral mandrel.

The shaped article preferably has a number of holes, corresponding to the number of cables or cores of the breakout. When forming the gel into such a shaped article the holes are formed preferably slightly smaller than the size of the cable that is to be inserted therein. The gels used in the invention will stretch to accommodate the increased size cable and the tension created provides a better seal. The number of holes should correspond to the number of cables to pass therethrough. The holes may be stretched by placing tubes, mandrels or other articles in the holes to keep them in an expanded condition prior to placing the shaped article around the cables. The tubes mandrels or other articles may be an integral part of the mold itself or they may be interested later prior to placing the shaped article around the cable. The tubes may then be removed when the shaped article is in place. A hole may also be larger or the same size as the cable. There is preferably a slit extending from the edge of the hole to the outer edge of the article so that the shaped article may be placed around the cables without access to the free end of the cable. The slit may be formed by using one or more tubes end insertion with an additional piece of material target to the edge of tube which runs to the edge of the mold which forms an integral pact of the mold of the invention. (See e.g. Figure 1 and 2).

When the shaped article is to be used to seal a cable end, if a hole is used, the hole should not pass all the way through the shaped article. The tube used to make the hole should therefore not pass all the way from top to bottom in the mold. The shaped article need not have any hole. rather, it must be at least slightly larger than the cable end and substantially conform thereto. In this case no tubular insert need be used. The shaped article will provide the environmental seal necessary and be held in place by enclosure used.

The polymeric gel is selected such that it has a cone penetration value as measured by ASTM D-937-77, of from about 30 to about 400 (10^{-1} mm) and preferably from about 50 to about 350 (10^{-1} mm). Further, said gel is selected such that it has an elongation, as measured by ASTM D-412, of from about 25% to about 850% and more preferably from about 100% to 750%. The gels may further be selected for their insulation, stress grading, or conductive properties as well as sealing. Generally, it is preferable that the gel should have a dielectric constant (permittivity) of less than 6 at 50 Hz for insulating gels and greater than 6 for stress grading gels (as measured by ASTM D-150). Where the gel is used as insulation as well as sealing, the gels preferably have a volume resistivity of at least 10^{10} ohm-cm (as measured by ASTM D-257). For stress grading applications, the gels preferably have a specific impedance of 10^{7} -10^{10} ohm-cm at 50 Hz (ASTM D-150), and for conductive applications, the gels preferably have a volume resistivity of less than 10^{7} ohm-cm. The gel posses sufficient tack to

seal and adhere to the breakout or a cable end. Further the properties of the gel allow cable movement without breaking the seal formed, due to the gels ability to deform and return to its substantially original shape while maintaining the tack necessary to seal.

Preferred gels for use in this invention are gelloid compositions comprising a crosslinked non-silicone polymer having an olefinic unsaturated content of less than 10 mole percent and having dispersed therein a liquid in an amount of from about 20% to about 95% by weight based on the weight of the liquid and polymer and from 0 to 0.3 volume fraction of a filler, said cross-linked polymer

a) if derived from a solid, relatively high molecular weight polymer, having a gel fraction of at least about 50%, or

b) if derived from a liquid, relatively low molecular weight polymer, having at least about 0.1 (preferably from about 0.1 to about 3) crosslinks per weight average molecule;

said composition having a storage modulus of $(1+2.5v+14.1v^2)x$ dynes/cm^2 wherein x is less than $5x10^5$ at 30°C and greater than $5x10^2$ at 90°C, and v is the volume fraction of the filler, with the proviso that, if the crosslinked polymer is prepared from a solid high molecular weight polymer, the storage modulus at 140°C is at least about 70% of the storage modulus at 70°C, and a dynamic

viscosity of $(1+2.5v+14.1v^2)y$ poises wherein y is less than $1x10^5$ at 30°C and greater than $5x10^2$ at 90°C and v is the volume fraction of the filler, said composition exhibiting first degree blocking.

These compositions are preferably prepared by subjecting a non-silicone liquid polymer containing from about 20% to about 95% by weight of a liquid to a crosslinking means such as a chemical means or irradiation means. The polymer starting material is a crosslinkable liquid polymeric material, preferably a non-silicone liquid rubber, with low or no unsaturation prior to crosslinking. The liquid polymeric material preferably has a molecular weight of less than about 90,000, preferably less than about 50,000, and a Mooney viscosity of ML 1+4 at 100°C of less than 10. Mooney viscosity is measured by ASTM D-1646. Said polymers are primarily liquids at these molecular weights and viscosities. The liquid polymer preferably has a molecular weight less than about 7.5 times the polymer's critical molecular weight (see e.g. Mechanical prop of Polymers, Nielsen 1962 for a discussion of critical molecular weight). The polymers can be a hydrocarbon backbone polymer or a polymer containing carbon as well as other atoms, e.g. oxygen, nitrogen, etc. in the backbone with the exception of silicone. The polymers are limited to those which have low or no unsaturation prior to crosslinking. In general, the amount of unsaturation will be less than about 10% mole, preferably less than about 7 mole percent and preferably less than 4 mole percent. If the unsaturation is too high the resulting product tends to be thermally unstable.

Preferred liquid polymeric materials include liquid butyl rubber, epichlorohydrin rubber, ethylene-propylene-diene monomer rubber (EPDM), hydrogenated polyisoprene, hydrogenated polybutadiene, hydrogenated styrene-butadiene rubber (SBR), hydrogenated polychloroprene, functionalized polyisobutylene (i.e. polyisobutylene with reactive groups added that are capable of crosslinking such as hydroxy, amine or carboxy groups), chlorinated polyethylene, liquid fluorinated polymers (e.g. Viton from DuPont), hydrogenated nitrile rubber and other hydrogenated liquid polymers. Further, one can combine the various polymers to form compositions of desired properties.

The liquid dispersed in the crosslinked polymer in accordance with this invention can be any liquid which is capable of being dispersed in the polymer in an amount from about 20% to about 95%, and which does not react during crosslinking of the polymer. The liquid may be a plasticizer, compatibilizer, tackifier, or the like. Suitable liquids include, for example, paraffinic oils, naphthenate oils, aromatic oils, liquid polybutenes, alkyl (or aryl) phthalates, vegetable oils, mineral oils, trimellitates, esters of polyethylene glycols, alkyl (or aryl) phosphates, methyl ester of hydrogenated wood rosin, liquid rosin oils, pine tar, polyterpenes, non-reacting liquid rubbers, the starting liquid polymer which remains uncrosslinked or at least crosslinked less than .1 crosslink per weight average molecule, and the like.

Crosslinking may be by any conventional crosslinking means, preferably UV means, irradiation means or by chemical

means. Radiation crosslinking can be accomplished by electron beam, or the like treatment. Suitable crosslinking promoters can be incorporated to encourage radiation crosslinking such as triallylcyanuate and triallyliso-cyanuate. Suitable chemical crosslinking agents can be chosen based on the individual polymer or polymers used. For example, a phenolic resin or p-quinone dioxime can be used to cure butyl rubber, peroxide can be used to cure EPDM or diisocyanate dimer acid can be used to cure epichlorohydrin rubber.

Optionally, plasticizers may be added to help obtain a gelloid with the desired cone penetration values. Such plasticizers preferably would include all liquids which are capable of reducing the viscosity of the base rubber, have low or no unsaturation as described above and are compatible with the base rubber.

A filler may be added to the composition, if desired. Generally, the amount of filler added is from 0 to 0.3 volume fraction. Preferably, the filler is in an amount from .1 to 0.2 volume fraction. The term "filler" is used herein to include all solid additives including particulate matter or fibrous matter present in the composition. These fillers include pigments, fillers known for conductive, (both electrical and thermal) stress grading and insulative purposes e.g. carbon black, barium titnate, zinc oxide, iron oxide, silicone carbide, metals and the like, reinforcing agents, thermal stabilizers, fungicides, biocides, flame retardants, for example, aluminum trihydrate, and the halo-

genated flame retardants, leak indicators (i.e. chemicals which react upon exposure to certain chemicals), corrosion inhibitors, ultraviolet light stabilizers, processing aids, impact modifiers and the like.

The compositions are formed preferably by mixing a liquid non-silicone polymer with any desired fillers in an amount of from 0 to 0.3 volume fraction, any crosslinking agents or the like and the liquid and subjecting the mixture to a crosslinking means. The composition will generally take the shape of the container during crosslinking but can be reshaped e.g. by cutting as desired.

The term cable is used in this application to refer to one or more electrical conductors surrounded by electrical insulation. In the case of a breakout, two or more cores, i.e. conductor and insulation, are divided from a main cable which contains those cores surrounded by a common insulation layer, optionally with shielding and/or armoring. A sealing method is applied to seal between the individual cores and the individual cores and enclosure. The term cable in the general description and claims is to be understood to cover the individual cores of a breakout or the main cable or the like. In the case of a branch-off two or more cables are jointed to a main cable. The term breakout is used herein to apply to such branch-offs as well as breakouts.

The shaped article and/or the mold or mandrels of the invention can contain various additives as desired.

Additives include, for example, stabilizers, reinforcing or non-reinforcing fillers, pigments, carbon black, plasticizers, surfactants, processing aids, corrosion inhibitors, conductive fillers, fungicides, biocides, leak indicators, and the like.

A packaged gel article is formed by assembling a mold comprising a material as previously described. In a preferred embodiment, the mold has additional mandrels or other inserts or means for forming holes partly or wholly through the shaped article. In a further preferred embodiment, the mold is provided with a means for introducing a slit between the hole and the edge of the shaped article. A preferred means for forming slit comprises a polymeric sheet placed between the hole forming means and the edge of the mold. The mold is closed after the liquid composition capable of forming a gel is placed therein and the mold is held together by any convenient means such as adhesives, mastics, clamps, or the mold is held together by the tack of the gel holding the molds parts in place or by the close tolerance and friction of the parts of the mold. The liquid composition is then set by curing, crosslinking or the like as appropriate for the chosen gel. The packaged gel article is then suitable for storage of the shaped article and furthermore is useful for handling the shaped article during installation an a cable breakout, cable end or the like without the handling difficulties associated with tacky materials. A portion of the mold may be broken away to give access to a large enough portion of the gel to make the installation. The installer will handle the gel by a por-

tion of the mold remaining around the gel after removal of a portion of the mold to give access to the area to be installed. After installation the remaining mold may be removed or may remain to act as a mechanical protection cover or cover for the shaped article that is exposed to the environment.

In the drawings Figure 1 is a disposable mold that forms a container that a shaped article of polymeric gel can be stored in. Figure 2 is an exposed view of Figure 1 wherein 1 is the top portion which is left off while the uncured polymeric gel is added to the mold and then put on to cure and store the gel. The hole forming means 2 is a tubular insert which when placed in the mold fits in holders 3 and 4 in the top 1 and bottom 5 portions also the hole forming means has an additional piece 6 for forming a slit in the shaped article. The body 7 of the mold is an oval piece form from a sheet of disposable material. Once the gel is formed in said mold the top 1 and bottom 5 as well as any hole or slit forming means 2, 6 may be removed for installation. The installation would handle the shaped article by holding mold body 7 until the shaped article is in place and then removing the mold body. Figures 3 and 4 show shaped article 8 and 11 of a polymeric gel, formed from a mold used in the invention. The articles each have holes 9 for positioning cables therethrough and slits 10 for positioning the shaped article around cables without access to the free end of the cable. Figure 5 shows a shaped article 12 with a hole 13 a portion of the way for positioning a cable end therein. Figure 6 shows a shaped article having holes

wherein the edges are open formed by mandrels which are an integral part of the mold.

The following example is illustrative only and is not to be construed as limiting the invention. One skilled in the art would readily be able to select appropriate crosslinking agents, crosslink promoters, gels, radiation levels, cable breakouts, sets of cables, cable ends, enclosures, adhesives, mastics, etc. for a particular application without undue experimentation.

Example 1

A mold is made according to Figure 1 of a poly carbonate material having a flexural modulus of 3.4×10^5 by injection molding. An uncured liquid butyl rubber is placed inside and the liquid butyl rubber is crosslinked to form a gel.

What is claimed is:

1. A packaged gel article comprising a mold and a shaped article:

a) said mold comprising a hollow cylindrical configuration having a circumference substantially corresponding to the shaped article which is in the mold;

b) at least one cylindrical mandrel positioned in the mold such that the shaped article has one or more holes extending at least partially therethrough;

c) said mold having therein a shaped article comprising a polymeric gel. The gel having a cone penetration value of about 30 to about 400 (10^{-1} mm) and an elongation of from about 25% to about 850%

d) said mold and mandrels being made of a relatively rigid material having a flexural modulus of at least about $4x10^3$ psi that is substantially incompatible with the shaped article, is dimensionally stable at the temperature the gel was formed at and has a release rate from the gel composition of at least 0.02 in/sec on 180° peeling.

2. An article according to Claim 1 wherein the mold and/or mandrel material are polymeric.

3. An article in accordance with Claim 1 wherein said polymeric gel comprises a crosslinked non-silicone polymer having an olefinic unsaturated content of less than 10 mole percent and having dispersed therein a liquid in an amount of from about 20% to about 95% by weight based on the weight of the liquid and polymer and from 0 to 0.3 volume fraction of a filler, said cross-linked polymer

a) if derived from a solid, relatively high molecular weight polymer, having a gel fraction of at least about 50%, or

b) if derived from a liquid, relatively low molecular weight polymer, having at least about 0.1 crosslinks per weight average molecule;

said composition having a storage modulus of $(1+2.5v+14.1v^2)x$ dynes/cm^2 wherein x is less than $5x10^5$ at 30°C and greater than $5x10^2$ at 90°C, and v is the volume fraction of the filler, with the proviso that, if the crosslinked polymer is prepared from a solid high molecular weight polymer, the storage modulus at 140°C is at least about 70% of the storage modulus at 70°C, and a dynamic viscosity of $(1+2.5v+14.1v^2)y$ poises wherein y is less than $1x10^5$ at 30°C and greater than $5x10^2$ at 90°C and v is the volume fraction of the filler, said composition exhibiting first degree blocking.

4. An article in accordance with Claim 3 wherein said polymeric gel is derived from a liquid, low molecular weight polymer.

5. An article according to Claim 1 wherein the polymeric gel has a slit between the edge of the hole and the edge of the shaped article.

6. A method of manufacturing a shaped article having one or more holes extending at least partially therethrough, which method comprises:

a) selecting a mold comprising a hollow cylindrical configuration having a circumference substantially corresponding to the desired dimension of the shaped article; said mold being closed at one end;

b) placing in the mold a liquid composition to a depth sufficient to provide the desired configuration of the shaped article, said composition comprising a polymeric material capable of forming a gel;

c) positioning at least one cylindrical mandrel at least partically through the liquid composition to displace the liquid material; and

d) subjecting the polymeric material to conditions to provide a gel composition having a cone penetration value of 30 to 400 (10^{-1} mm) an elongation of about 25% to about 850%;

said mold and mandrels being made of a relatively rigid material having a flexural modulus of at least about $4x10^3$ that is substantially incompatible with the shaped

article, is dimensionally stable at the gel forming temperature and has a release rate from the gel composition of at least 0.02 in/sec on 180° peeling to obtain a shaped article having one or more holes extending at least partially therethrough, the number of holes corresponding to the number of mandrels used in step (c).

7. A method of manufacturing according to Claim 6 wherein the mold and/or mandrel material are polymeric.

8. A method of manufacture wherein the gel composition comprises a crosslinked non-silicone polymer having an olefinic unsaturated content of less than 10 percent and having dispersed therein a liquid in an amount of from about 20% to about 95% by weight based on the weight of the liquid and polymer and from 0 to 0.3 volume fraction of a filler, said cross-linked polymer

a) if derived from a solid, relatively high molecular weight polymer, having a gel fraction of at least about 50%, or

b) if derived from a liquid, relatively low molecular weight polymer, having at least about 0.1 crosslinks per weight average molecule;

said composition having a storage modulus of $(1+2.5v+14.1v^2)x$ dynes/cm^2 wherein x is less than $5x10^5$ at 30°C and greater than $5x10^2$ at 90°C, and v is the volume fraction of the filler, with the proviso that, if the

crosslinked polymer is prepared from a solid high molecular weight polymer, the storage modulus at 140°C is at least about 70% of the storage modulus at 70°C, and a dynamic viscosity of $(1+2.5v+14.1v^2)y$ poises wherein y is less than $1x10^5$ at 30°C and greater than $5x10^2$ at 90°C and v is the volume fraction of the filler, said composition exhibiting first degree blocking.

9. A method in accordance with Claim 8, wherein said polymeric gel is derived from a liquid, low molecular weight polymer.

10. A method of manufacturing according to Claim 8 wherein the polymeric gel has a slit between the edge of the hole and the edge of the shaped article.

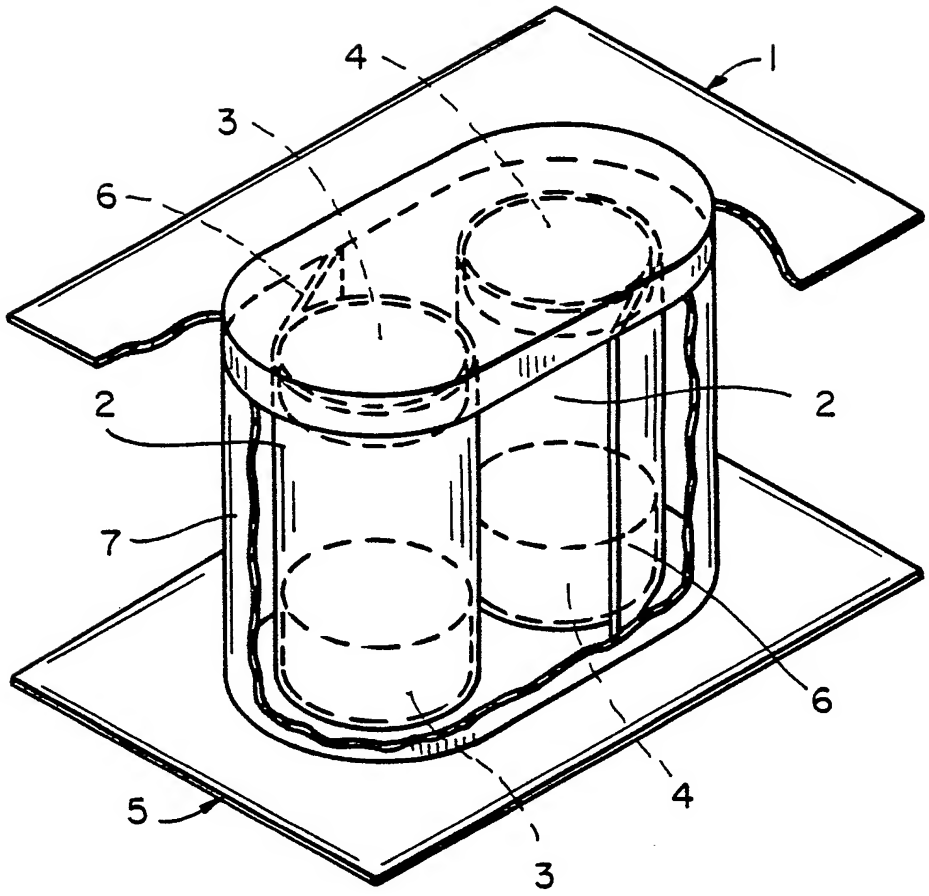

FIG_1

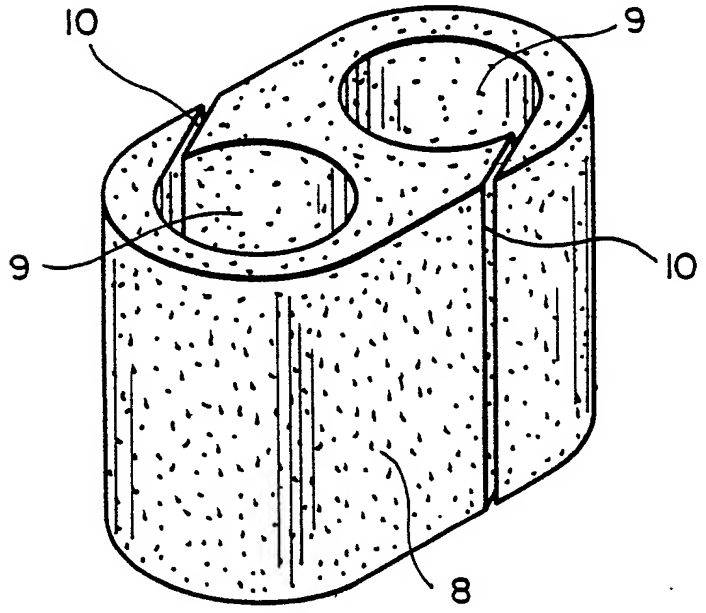

FIG_3

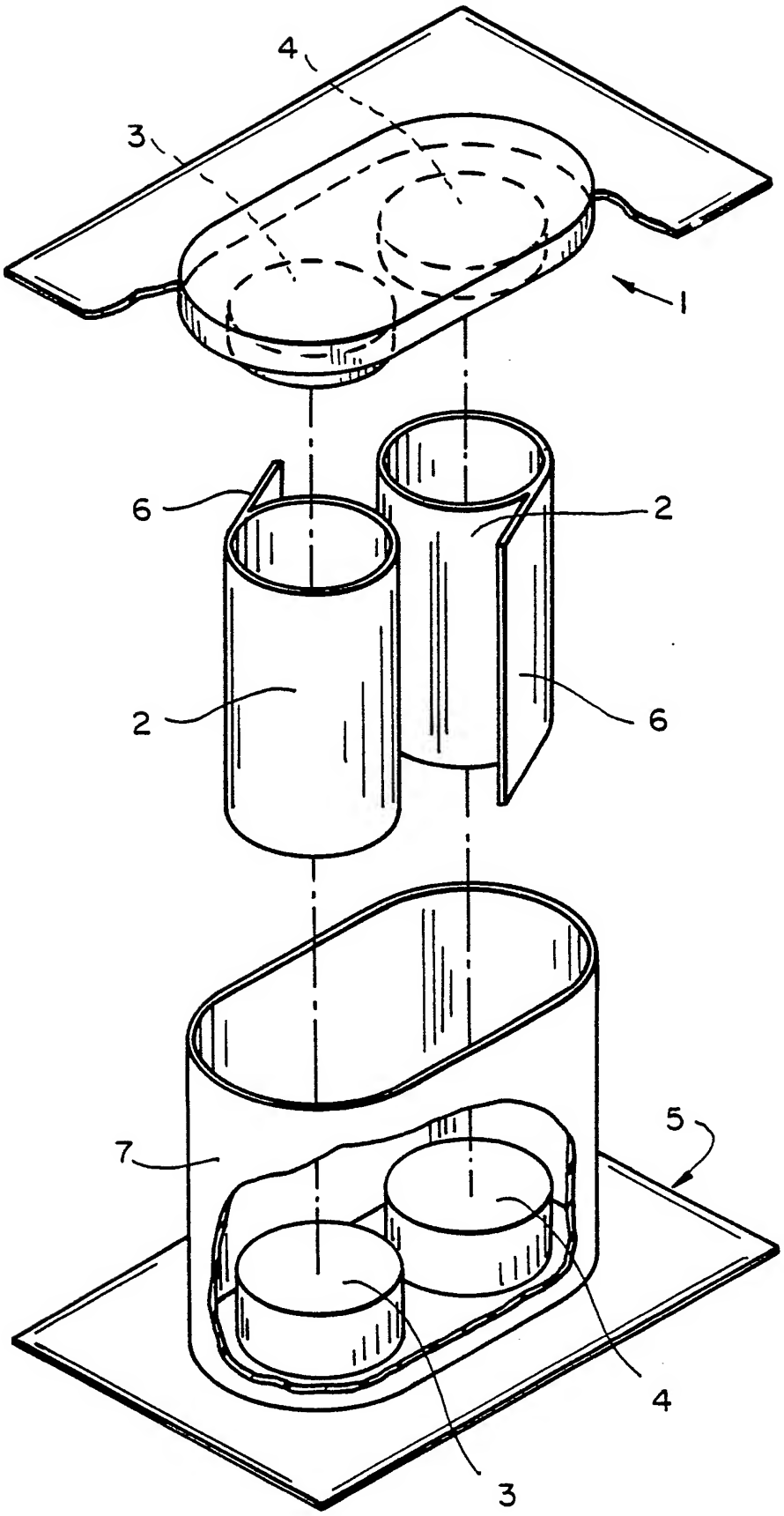

FIG_2

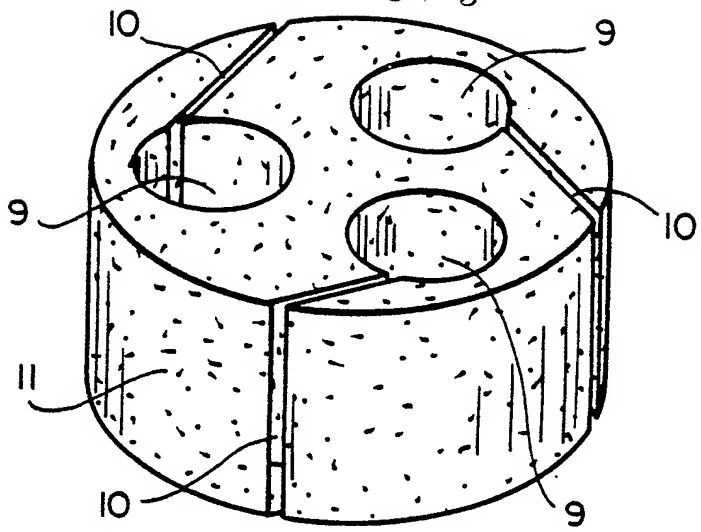

FIG_4

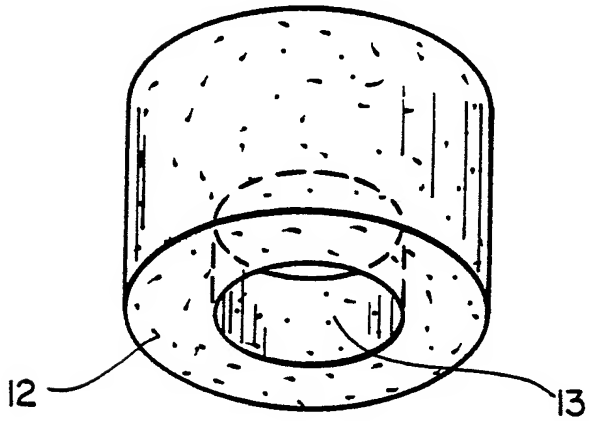

FIG_5

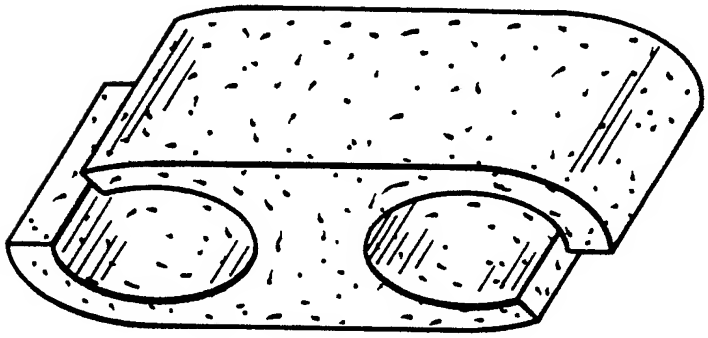

FIG_6

INTERNATIONAL SEARCH REPORT

International Application No PCT/US86/00967

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC (4): B28B 7/16; B28B 7/28; B29C 39/02; H01B 13/22
U.S. Cl.: 264/267; 156/51; 249/142; 249/176

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
U.S.	156/49, 51, 52 174/88R, 92, 93 249/134, 142, 144, 176, 177, 183 264/267, 318, 337

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
Y	US, A, 2,771,502 (King et al) 20 November 1956, see column 4, lines 40-71.	1-10
Y	US, A, 3,015,847 (Holden et al) 09 January 1962, see entire document.	1-10
Y	US, A, 3,564,661 (Atwell) 23 February 1971, see column 2 and column 4.	1-10
Y	US, A, 4,027,845 (Putzer) 07 June 1977, see entire document	1-10
Y	US, A, 4,248,823 (Bader et al) 03 February 1981, see entire document.	1-10
Y	US, A, 4,294,792 (Arons et al) 13 October 1981, see column 7, lines 21-65.	1-10
Y	US, A, 4,480,975 (Plummer et al) 06 November 1984, see column 4, lines 25-58.	1-10
Y,P	US, A, 4,565,348 (Larsen) 21 January 1986, see column 4, lines 13-22.	1-10

* Special categories of cited documents: [15]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
30 June 1986	05 AUG 1986
International Searching Authority [1]	**Signature of Authorized Officer [20]**
ISA/US	Leo B. Tentoni Leo B. Tentoni

Form PCT/ISA/210 (second sheet) (October 1981)

PUB-NO: WO008606316A1

DOCUMENT-IDENTIFIER: WO 8606316 A1

TITLE: SEALING ELEMENT AND METHOD OF MAKING SAME

PUBN-DATE: November 6, 1986

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ASSIGNEE-INFORMATION:

NAME	COUNTRY
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APPL-NO: US08600967

APPL-DATE: May 2, 1986

PRIORITY-DATA: US73040885A (May 2, 1985)

INT-CL (IPC): B28B007/16 , B28B007/28 , B29C039/02 , H01B013/22

EUR-CL (EPC): B29C033/00 , B29C033/00 , B29C039/00 , H01R004/70 , H02G015/013

US-CL-CURRENT: 156/51 , 249/142 , 249/176 , 264/267

ABSTRACT:

CHG DATE=19990617 STATUS=O>A sealing element comprising a mold (7) with a hollow cylindrical configuration having therein a polymeric gel with a cone penetration value of about 30 to about 400 (10<-1> mm) and an elongation of from about 25% to about 850% and at least one cylindrical mandrel (2) positioned in the mold (7) such that the polymeric gel has one or more holes extending at least partially

therethrough. The mold (7) and mandrels (2) are made of a material having a flexural modulus of at least about 4 x 10<3> psi that is substantially incompatible with the polymeric gel, is dimensionally stable at the temperature the polymeric gel was formed, and has a release rate of at least 0.02 in/sec on 180 peeling. A method of making a sealing element is also disclosed.